The INSTITUTE Spokesman

DECEMBER, 195[illegible]

OFFICIAL PUBLICATION

NATIONAL LUBRICATING GREASE INST NLGI

from
Witco's
seven plants,
season's
greetings
and
best wishes
for the
new year

WITCO CHEMICAL COMPANY · 295 MADISON AVENUE, NEW YORK 17, N. Y.

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In This Issue

DECEMBER, 1950

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ABOUT THE COVER

The problem of processing-material storage is an important one for every manufacturer. Palletized storage has been the answer in many instances, especially where space is at a premium. This form of modern storage not only requires less floor space but also reduces handling costs. The fork-lift stacks pallets as high as the ceiling permits, as shown in the front cover illustration. The pallets are easily stacked or unstacked, and may be quickly transported, by means of the fork-lift truck, from remote warehouse areas to the processing equipment as the material is needed.

American Cyanamid Company pioneered in packing Metallic Stearates in multi-wall paper bags, containing 25 lbs. net each. The bags are five ply, of which the outer layer is wet-strength paper, for still greater protection. This form of packaging with its many other advantages permits users of stearates to also take advantage of the economies of palletized storage. Grease makers have welcomed as a significant contribution to the production of better greases at lower cost both the forward step in packaging as well as the greatly improved grades of AERO Metallic Stearates, specialized for the Grease Industry.

LUBRICATE FOR SAFETY
- EVERY 1,000 MILES -

President's page

by Howard Cooper, President, N.L.G.I.

Christmas 1950

The confusing world turmoil in which we have been living, and which persists threateningly, gives us reason for pause at this Christmas season to ponder what the wise men and shepherds heralded on that starlit night when an unusual holy birth was revealed to them. With great rejoicing a new era was hailed—an era of peace on earth and good will toward men.

We have come 1950 years since that first Christmas, and again this year we are under the dark clouds of war so that the goal of peace and human kindness seems still beyond our reach. Yet we must not let hope wane, for to do so is to be lost.

Looking back into history we are reminded of the tyrants whose reigns have been overthrown, and of the freedoms gained over the centuries by millions of the world's population. To be sure, there have arisen repeatedly men of selfish ambition to challenge these freedoms, and to impose self-glorifying domination in their place. These have been successful for a time, but none has lasted. That is significant. While there have been many obstacles in the way to lasting peace, we should not lose sight of these experiences in history; for they are a source of hope and strength when in weariness our spirit may tend to lag. We cannot afford to falter; we must press on.

As a proud part of a still free America, the N.L.G.I. prayerfully encourages all sincere peace-seeking bodies and individuals in every constructive effort to achieve the full realization of the Christmas spirit—". . . and on earth peace, good will toward men".

Figure 1

"Figure 1 shows three test units set up with connections to the panel board. A test unit consists essentially of a test bearing mounted on a spindle which in turn is supported on suitable anti-friction bearings in a housing and driven by an electric motor by means of a flat belt."

A Method for Testing *High Temperature Performance* of Greases

by W. J. Finn
Beacon Research Laboratories
The Texas Company
Beacon, New York

• The National Lubricating Grease Institute does not necessarily endorse the method presented in this article and the American Society for Testing Materials, through Technical Committee G, is currently developing a similar method for testing of greases for possible standardization.

Grease, the versatile lubricant, has risen to an enviable position in the Petroleum Industry. In the attainment of this status, grease research has paralleled bearing industry research, aircraft and automotive industry developments and instrument builders' designs. In thus keeping up with the trends in industry, grease has contributed prominently to the development of machinery capable of furnishing more output for the power input, with greater dependability, over wider ranges of temperature.

Any grease, of course, must be prepared to function satisfactorily under the expected operating conditions. The laboratory anticipates this by using full scale bearing test devices.

This article presents details of a method of test for evaluating high temperature greases. The objective in working out the test procedure was to simulate operating conditions as closely as possible attempting to correlate laboratory testing with actual field practice when using conventional bearings.

Many years ago when petroleum products included chiefly kerosene and a few heavier lubricating oils, the petroleum chemist discovered that the latter could be thickened by mixing with soaps. This was a happy discovery because it furnished a lubricant which would remain longer in the comparatively large bearing clearances that prevailed, with less chance of dripping out to foul the machinery and create a slippery hazard on the floor. The term grease—long applied to animal fats—was likewise applied to this petroleum compound.

Since those days—scarcely a lifetime ago—machine design and petroleum refining have come a long way. The machinery builder today is continually working to closer tolerances and towards precision finishing of machine parts. The petroleum chemist has adopted a multitude of scientific procedures to guide him in refining and compounding of lubricants which will enable these precision machines to develop the mileage of the modern motor car; to maintain, air, rail, marine and highway transport timetables; to produce the necessities of our modern civilization.

So the petroleum scientist evaluates his lubricants under the prospective operating conditions, before he presents these products to the customer. It is necessary to be sure they will perform as expected. The procedure in evaluating the high temperature performance of a modern grease is a case in point. How it is carried out is of interest.

Scarcely ten years ago greases had to be adaptable only to a temperature range of between about minus 10°F. and plus 250°F. Military requirements and the aviation industry called for lowering the minimum service temperature requirements to a specified 67°F. below zero and for some special installations to 100°F. below zero. Greases were developed to meet those requirements giving trouble-free operation under the lowest temperature conditions encountered.

At the same time, special requirements of military equipment and the development of such improvements as silicone insulation for electric motors extended the desired upper temperature range for greases to at least 300°F. The military specified a minimum useful grease life of three hundred hours when used in an anti-friction bearing operating at 10,000 r.p.m. and at a temperature of 300°F. Today the goal is a grease service life of 1000 or more hours under the same conditions. In addition, scientific investigators and designers of gas turbines, turbojets, and other machinery are looking forward to the availability of satisfactory lubricants for operation at temperatures as high as 400°F. to 500°F. at high rotative speeds. Such a lubricant must also possess extended service life so that the period between overhauls can be extended.

This widening of the desired operating temperature range assumes added significance when it is realized that greases which might perform satisfactorily for thousands of hours at 250°F. might last only a few hundred hours at 300°F., and further temperature increases reduce the service life even more drastically as will be shown later in this article.

There used to be a time when appearance, feel, and penetration were the criteria by which greases were judged. That is no longer true. Today, each new grease developed, whether it be an improved product for ball and roller bearings or "tailored" for some other specific application, must be evaluated under conditions that simulate those under which it will be required to function in service. The petroleum industry has dovetailed grease development with chemical and mechanical evaluations not only to determine specific grease properties but also to guide the research chemist in his development work on new products. This teamwork has been exemplified during the development of greases for high temperature-high speed applications.

The dependability with which modern greases designed for this service are functioning is evidence of the value of the laboratory work which has attended their preparation. With the knowledge that such greases are available, the reader should be interested in knowing how the laboratory makes sure that they are suited to his particular operating conditions.

HOW THE PROBLEM WAS APPROACHED

As is well known to all who have had experience with research, the method of approach in solving any new problem must of necessity go through a transitory status. From an economic point of view, it is always advisable to look into the applicability of existing machinery before developing new apparatus. Very often it is possible to arrange a combination of operating mechanisms and measuring instruments to good advantage. This becomes especially practicable in any study involving ball or roller bearings where the degree of lubrication from any type of lubricant is to be studied under extremes of speed and temperature.

This procedure was followed in the preliminary investigational work on the subject under discussion, i.e. high temperature performance testing of greases. Certain fundamentals pertaining to design and installation soon became evident from early work.

1—Each individual test unit should be mounted in a firm installation to avoid excessive vibration.

2—The main shaft carrying the test bearing and driving motor connections should be as short as possible to eliminate "shaft whip."

3—This shaft should be of hardened steel to reduce the wear induced through assembly and disassembly of the unit.

4—Adequate provision should be made for even heat distribution around the test bearing. This is particularly important where bearings and lubricants are to be tested under high temperature conditions.

All the foregoing pointed to the necessity of designing a special machine. This unit was planned so as to eliminate as far as possible any mechanical factors that might contribute to machine failure and thereby possibly disqualify an experimental grease that looked good, or so confuse the results on a planned series of experimental products that no valid conclusions could be drawn. Ideally, a mathematical representation of the test would indicate the machine factors as constants with only one variable present, the grease under test.

DETAILS OF THE MACHINE

Figure 1 shows three test units set up with connections to the panel board. A test unit consists essentially of a test bearing mounted on a spindle which in turn is supported on suitable anti-friction bearings in a housing and driven by an electric motor by means of a flat belt. Figure 2 is a cross-section view which shows the test unit held in the pedestal and surrounded by the heater chamber. The pedestal is mounted on top of a firm base with the drive motor mounted on a pivoted base below. A flat woven linen belt rides on the motor and spindle drive pulleys.

TYPE OF SPINDLE

The spindle on which the test bearing is mounted is made of a high grade alloy steel and heat treated after rough grind-

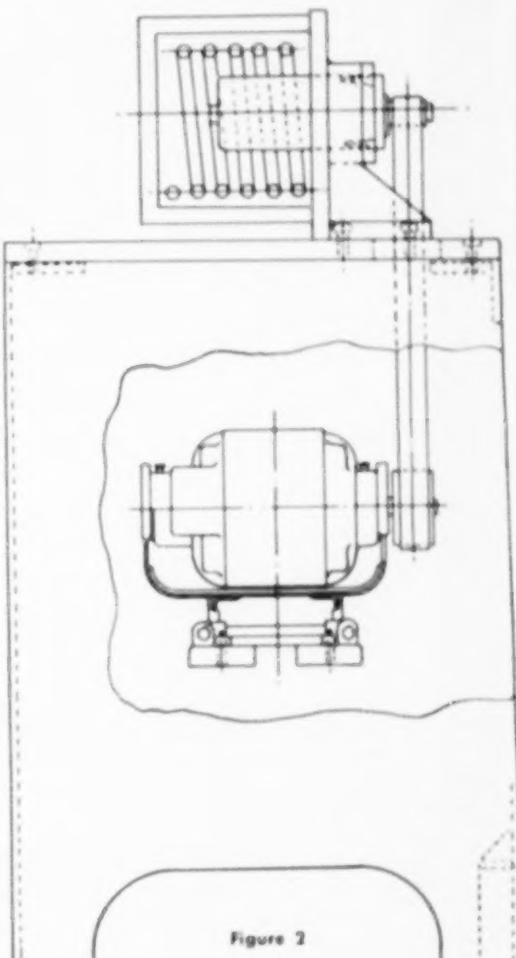

Figure 2

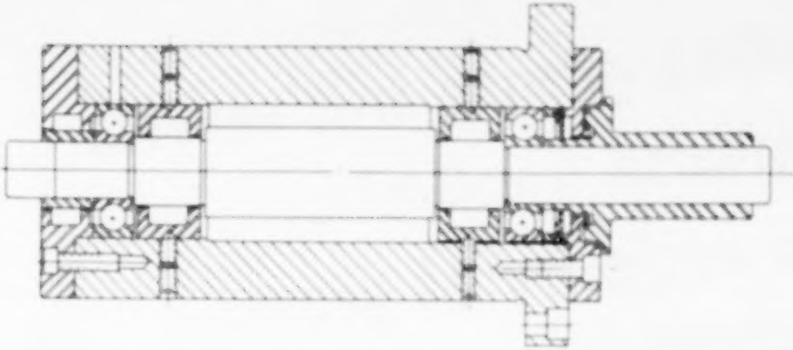

Figure 3

"Figure 3 is a cross-section of the spindle and the housing assembly."

ing to relieve all stresses. The diameters are held to within one ten-thousandth of an inch concentricity and the spindle is dynamically balanced so as to preclude vibration. The distance between the support bearings is small and the overall length is under eleven inches. These distances are held at a minimum to further reduce vibration and shaft whip at the desired speed of 10,000 r.p.m.

FRETTING CORROSION ELIMINATED

Previous experiences with high speed-high temperature test machines indicated considerable trouble with fretting corrosion of the spindle surfaces which the test bearings contacted. In order to obviate this factor, the surfaces on which the test bearings are pressed have been chrome-plated. This was done by grinding the surfaces 0.002 inch undersize, chrome-plating to 0.003 inch oversize, and then grinding to size. This procedure has effectively eliminated fretting corrosion of the surfaces over a period of two years.

Another feature of the spindle design is the use of press-fits for the bearings, pulley, etc. to eliminate unbalance which might occur if locking devices were used. Here again the chrome-plated surfaces have proven exceptionally resistant to wear over a long period of time during which the units were assembled and disassembled quite frequently.

Figure 3 is a cross-section of the spindle and housing assembly while Figure 4 is an exploded view showing the individual parts. The bearings, grease slingers or shields, pulley, and spacer rings are assembled on the spindle before inserting it into the housing.

HOUSING DETAILS

The spindle housing has an overall length of eight inches and a diameter of 3.5 inches. The housing has been provided with a 0.75 inch wall, for two reasons, first for rigidity and second for bulk to maintain a more uniform temperature distribution. The housing and cover plates act both as shields and as positioners for the outer races of the bearings. An adjusting spring is interposed between the end cover plate on the pulley end and the spacer ring which butts against the outer race of the outboard bearing.

LOADING

The clearances are such that a thrust load of 17.5 pounds is applied to the bearings. This load is applied only to main-

Figure 4

"Figure 4 is an exploded view showing the individual parts."

tain contact between the balls and races of the bearings when operated at 10,000 r.p.m.

No radial load is imposed on the test bearing other than that of the drive motor and belt tension caused by the angle of wrap on the small pulley. The total load is relatively small and is maintained as nearly constant as possible. The primary purpose in operating the test under no load, other than that sufficient to keep the balls and races in constant contact, is to hold the load as far as possible below the rated capacity of the bearings. The input of heat to the bearing must necessarily set up stresses in the bearing. Such stresses, if coupled with a load even approaching the capacity of the bearing, would bring the bearing back into the picture as a factor contributing to failure and reduce the sensitivity of the test as a grease evaluation mechanism.

FUNCTION OF THE SHIELDS

Although the housing cover plates serve as outside shields for the bearings, individual shields are provided for the inside. The inside shields have an annular space which functions as a trap to prevent oil or grease from migrating from the bearings to the shaft. These shields are carefully positioned and held in place by set screws in the housing. A slight clearance between the test bearing cover plate and the annular ring which holds the inner race of the bearing tightly against the shoulder of the spindle provides means for the escape of volatilized oil or oxidation products from the grease. It also enables a certain amount of "breathing" by the bearing, a condition which is usually but not always present in service.

TEMPERATURE MEASUREMENT

The measurement and recording of bearing temperatures is an important factor in this type of test since, as mentioned previously, slight variations in temperatures in this range have a pronounced effect on the grease life. A hole in the housing wall, shown in Figure 3, provides for the installation of a special type iron-constantan thermocouple. This thermocouple is a pencil type with its thermal junction in the tip. When in position, the thermal junction of the thermocouple contacts the periphery of the outer race of the test bearing. The temperatures measured are automatically recorded by an instrument mounted on the panel board.

Both the test and outboard bearings are ABEC* No. 3 Grade 204 ball bearings specially processed for high speed high temperature operation and are stress-relieved at from 350°F. to 400°F.

The test bearing housing bolts into a semicircular pedestal, 2.5 inches wide and designed so that when the housing is in position its centerline stands six inches above the top of the base. This pedestal also has a wide rim to which the bearing housing as well as the heater chamber are bolted.

Two heaters in the heater chamber provide sufficient heat to run the test bearing at temperatures up to and including 500°F. One heater has a rating of 1000 watts and the second 500 watts; both are 230 volt Calrod tubular heaters bent to conform to the heater chamber. The 1000 watt heater provides a constant heat and is controlled through a variac. Under test conditions the constant heater provides from 80 to 90 per cent of the required heat. The 500 watt heater operates intermittently to maintain the balance of the heat required. A DeKhotinsky thermo-regulator in the heater chamber, adjacent to the bearing housing, regulates the heat input of the intermittent heater. Temperature regulation has

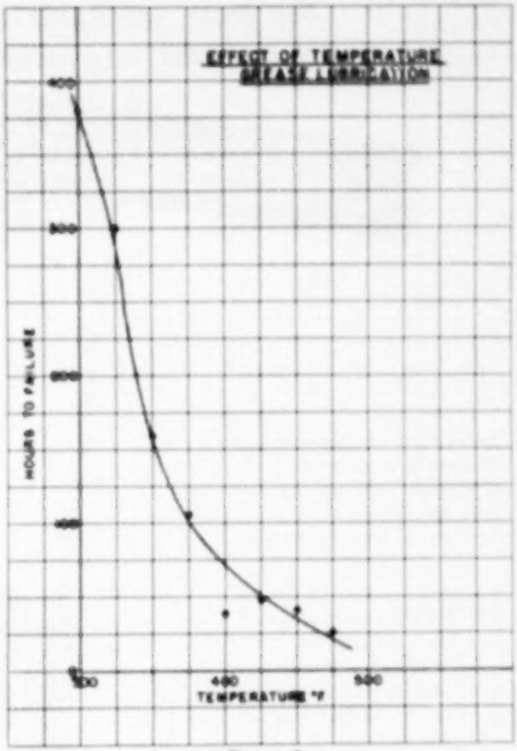

Figure 5

held within relatively close limits (± 5°F.) and test bearing temperatures up to and including 475°F. have been maintained. The assembly and disassembly of the test unit can be accomplished without disturbing the heaters or DeKhotinsky heat controller.

THE SPINDLE DRIVE

A 0.5 horsepower, 3450 r.p.m. 230 volt cradle-mounted electric motor drives the test spindle. This motor, as mentioned previously, rests on a pivoted base below the test unit and is belted to the test spindle pulley by a flat woven belt 1.25 inches wide. In order to reduce vibration to a minimum, the drive pulley on the motor was dynamically balanced and the rotor of the motor also checked for balance.

The ratio of diameters of drive pulley on the motor and pulley on the test spindle is approximately 2.9 to 1 for a speed of 10,000 r.p.m. However, the spindle speed was checked with a strobotac and adjustments made to bring the speed within that required. Belt slippage proved to be very low. Incidentally, both pulleys have a 2° crown. Various controls were tried in the motor circuit. However, the most satisfactory arrangement proved to be a heavy fuse in the starting circuit and a fuse somewhat below the full load requirement in the running circuit coupled through a double pole, double throw switch with neutral position.

The motor is started with the high amperage fuse circuit and, when speed is attained, the switch is thrown to the low amperage or running circuit. The rupture of the low amperage fuse when the load on the motor exceeds the fuse capacity

Figure 6

"Figure 6 shows the surface of a new unused bearing that was rejected by the screening test. It is evident from the condition of the surface that a surface tension had developed in the metal great enough to cause rupture."

determines the failure point of the test. Noises developed in the test bearing and temperature surges are observed and recorded, but are not considered in determining the failure point, although they may be indicative of imminent failure.

TEST PROCEDURE

The test procedure evolved for evaluating greases at high temperatures consists in charging 3.0 (±0.1) grams (approximately 50 per cent of full charge) to the test bearing with a narrow-blade spatula and working the grease well into the interstices of the bearing. The charged bearing is then rotated clockwise and again counterclockwise at 200 r.p.m. for one minute each to work the grease into the bearing. The outboard bearing, which does not operate in the high temperature zone, is lubricated with a high quality high temperature grease. The unit is now ready for assembly.

The unit is operated in cycles as follows: The motor is started and the heaters turned on simultaneously to bring the bearing temperature up to its predetermined level where it is maintained for the duration of the cycle. The machine is run for twenty-four hours counted from the start. A shutdown and cooling period of two hours follows the high temperature portion. This cycle is repeated until failure occurs.

The actual effect of the cooling period has not been fully determined. Judged by the number of failures on starting, it appears that a shellac-like formation on the races of the bearing hardens enough during the cooling period to cause skidding of the balls and seizure. The shellac-like formation, although present at the high temperatures, is apparently in a more plastic state at those temperatures and does not seriously hamper operation.

REPRODUCIBILITY OF TEST

A series of twenty-nine tests on eight different units was made using an uninhibited experimental grease of known performance characteristics on other high temperature test machines. This particular product did not have a very high useful life and by its use the time required for reproducibility studies was greatly shortened.

The data on these twenty-nine tests are presented in Table 1:

Unit No.	*Hours to Failure*	*Bearing Condition After Test*
1	182	Slightly rough
1	240	Seized
1	216	Seized
1	216	Very rough
2	206	Seized
2	120	Very rough
2	238	Very rough
2	216	Seized
3	230	Seized
3	214	Seized
3	240	Very rough
4	168	Seized
4	384	Seized
4	241	Seized
4	243	Very rough
5	143	Seized
5	168	Seized
5	144	Very rough
5	336	Seized
5	264	Seized
6	216	Seized
6	240	Seized
7	120	Seized
7	408	Seized
7	192	Seized
7	237	Seized
8	194	Seized
8	145	Seized
8	216	Seized

The average time to failure for the twenty-nine tests was 220 hours.

Twenty-one of the twenty-nine tests included in the average were within plus or minus two cycles of operation while 25 were within three cycles. The remaining tests were four cycles above or below the average.

It is realized that this is not a true average as a minimum of nine or ten tests on each unit would be necessary in order

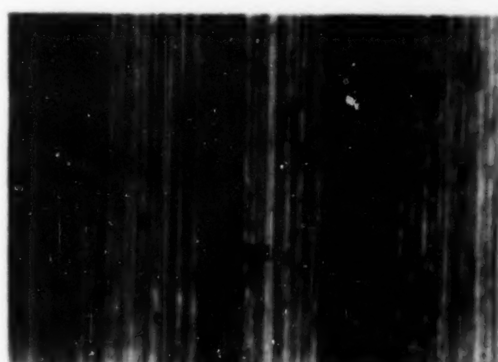

Figure 7

"Two distinct ball paths are seen in Figure 7. The narrow path developed under conditions of no load whereas the broad path was produced by a light thrust load which moved the ball path off center. The metal surface in the path has become rough but is not gouged."

to more nearly approach it. The results obtained, however, are considered to be within the limits of good reproducibility for this type evaluation. The determination of a true average would not be warranted due to the time and materials required.

EFFECT OF TEMPERATURE

The next logical step in the study of greases under high temperature conditions was to ascertain the effect of elevated temperatures, that is, above 300°F., on their lubrication characteristics. A grease that had a useful life of 380 hours at 300°F. and 10,000 r.p.m. on the High Temperature Performance Test was selected for the high temperature investigations. Figure 5 graphically represents the data obtained from a series of tests where the bearing temperature was raised from 300°F. to 475°F. in increments of twenty-five degrees. The useful life of the grease as indicated by hours to failure time shows a very rapid decline with an increase of 50°F. from 300°F. to 350°F. At 375°F. the useful life has been further reduced to approximately 25 per cent of the original life. Each further increase in temperature decreases the useful life until at a temperature of 475°F. the maximum time is one cycle of operation.

A large number of products have been evaluated at 450°F. This number included greases made with different soaps and blended with various viscosity oils, both mineral and synthetic.

The reproducibility of mechanical tests on greases is rather difficult and especially so at high rotative speed and high temperatures. Perhaps one of the greatest contributing factors is the disposition of the grease on the bearing when it has attained maximum speed. It is highly improbable that the same amount of grease will be retained on the bearing races and ball cage, or that the same amount of grease will be thrown out of the bearing to the shields in each of a series of tests on the same lubricant.

The bearings used for test purposes appear to be quite satisfactory. However, it is impossible to state definitely at this time just how much variation in the bearings contributes to variation in failure time. This is especially true in the

Figure 8

"The type of failure shown by Figure 8 was also made under no lead-starved lubrication conditions and high rotative speed; however, the failure had progressed to a point where the surface shows some flow of metal."

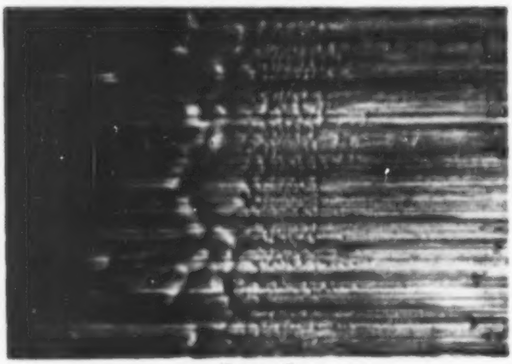

Figure 9

"The photomicrograph in Figure 9 illustrates a condition of good anti-friction bearing lubrication. This was produced by charging a new bearing with grease, assembling the bearing in the High Temperature Performance Test Machine, and rotating it at 10,000 r.p.m. for ten minutes."

Figure 10

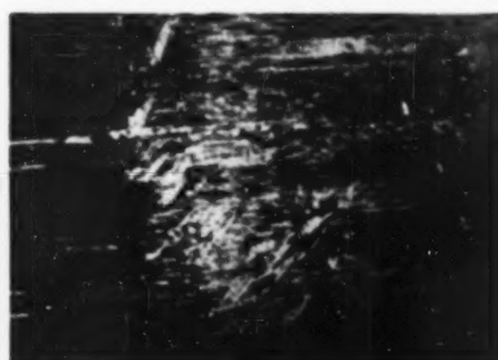

Figure 11

"Figures 10 and 11 show the surfaces of a bearing inner race that had been in operation for over 500 hours at 250 degrees F. bearing temperature and 10,000 r.p.m. Figure 11 shows a shellac-like material built up on the surface while Figure 10 shows the same surface that had been wiped with a cloth wet with a solvent."

300°F. to 450°F. bearing temperature range. Furthermore the quality of individual bearings for test purposes cannot be determined with any degree of accuracy, although a crude screening test does separate those bearings that are entirely unfit. A program is now in progress to discover a non-destructive method for evaluating bearings more precisely before they are placed on the grease test unit.

INDICATION OF STARVED LUBRICATION

An anti-friction bearing when operating under conditions approaching starved lubrication will develop a high pitched squeal. In the early work on testing greases for high temperature operation this squeal was taken as the failure point. However, examinations of the bearings after test frequently showed them to be in excellent condition and the grease still appeared to be suitable for continued operation. Further investigations revealed that although a noise developed in the test bearing, it would frequently fade out and the bearing would subsequently operate quietly. It was then assumed that when a noise developed, local heating also developed. This in turn drew more of the lubricant into the trouble area and starved lubrication conditions were relieved. Failure, however, is imminent when the noise persists or recurs frequently. A continued noise indicates that the grease itself has lost its feeding characteristics and is no longer able to maintain the proper film. The subject of failures will be more fully explained below.

EVALUATION OF PHOTOMICROGRAPHS

A number of photomicrographs are presented to illustrate the conditions of the grease at failure. All photomicrographs were taken with vertical illumination at 100X magnification and picture the surface of the bearing inner race on both sides of the path traveled by the balls during rotation.

Photomicrograph (Fig. 6) shows the surface of a new unused bearing that was rejected by the screening test. It is evident from the condition of the surface that a surface tension had developed in the metal great enough to cause rupture. This bearing would probably function very satisfactorily under service conditions but not for test purposes.

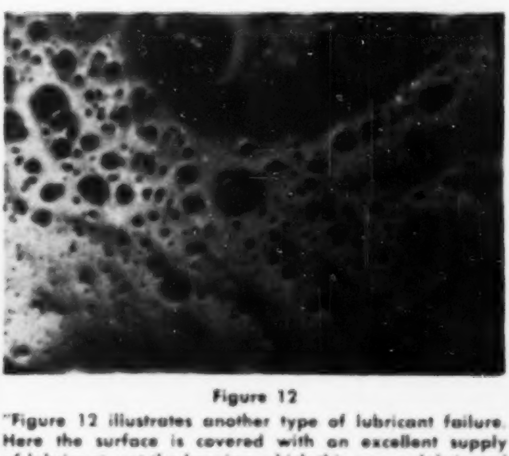

Figure 12

"Figure 12 illustrates another type of lubricant failure. Here the surface is covered with an excellent supply of lubricant, yet the bearing which this grease lubricated seized after six hours running at 450 degrees F. and 10,000 r.p.m."

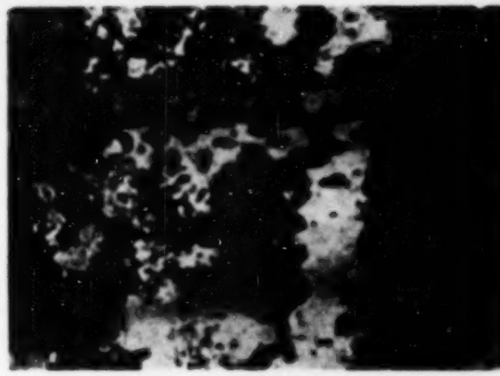

Figure 13

"Figures 13, 14 and 15 illustrate the various stages of the shellac-like deposit on the bearing surfaces as it changes from a shellac to a hard carbon with a gradual covering of the entire surface."

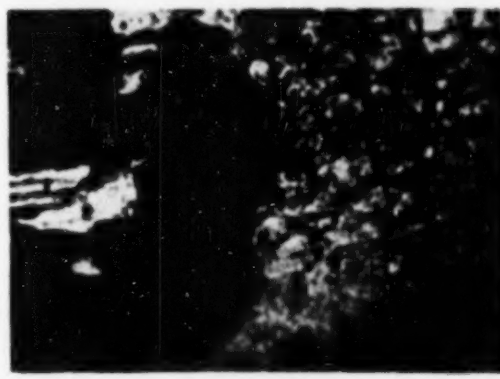

Figure 14

See caption for Figure 13

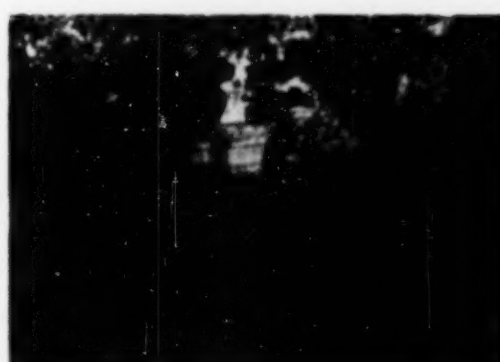

Figure 15

See caption for Figure 13

Photomicrographs shown by Figs. 7 and 8 illustrate two different types of failure. Those failures were developed at ordinary temperatures but under starved lubrication conditions and high rotative speeds.

Two distinct ball paths are seen on Fig. 7. The narrow path developed under conditions of no load whereas the broad path was produced by a light thrust load which moved the ball path off center. The metal surface in the path has become rough but is not gouged.

The type of failure shown by Fig. 8 was also made under no load-starved lubrication conditions and high rotative speed; however, the failure had progressed to a point where the surface shows some flow of metal.

The photomicrograph in Fig. 9 illustrates a condition of good anti-friction bearing lubrication. This was produced by charging a new bearing with grease, assembling the bearing in the High Temperature Performance Test Machine, and rotating it at 10,000 r.p.m. for ten minutes. The bearing at the end of the run was removed and carefully disassembled so as not to disturb the grease. The picture shows a wedge of built up grease followed by a gradually tapering film. The channel produced by the passage of the balls has filled in so as to present an unbroken film.

Figs. 10 and 11 show the surfaces of a bearing inner race that had been in operation for over 500 hours at 250°F. bearing temperature and 10,000 r.p.m. Fig. 11 shows a shellac-like material built up on the surface, while Fig. 10 shows the same surface that had been wiped with a cloth wet with a solvent. Although all of the deposit had not been wiped off, enough was removed to show the metal surface of the bearing. This bearing had seized at failure; consequently, one would expect to find a spalled or broken surface. This type of failure, however, seldom damages the surface of the bearing because it is due to a building up of shellac-like deposit that eventually reduces the clearances in the bearing sufficiently to cause seizure.

Fig. 12 illustrates another type of lubricant failure. Here the surface is covered with an excellent supply of lubricant, yet the bearing which this grease lubricated seized after six hours running at 450°F. and 10,000 r.p.m. An examination of the grease showed it to have developed an extremely tacky texture, which in all probability increased under the conditions of test to such an extent as to prevent the operation of the bearing.

Figs. 13, 14 and 15 illustrate the various stages of the shellac-like deposit on the bearing surfaces as it changes from a shellac to a hard carbon with a gradual covering of the entire surface.

Figure 16

"Figure 16 clearly shows the ball path running across the picture. This ball path has the same type of surface found on the bearing operated under starved-lubrication conditions . . . This particular grease lubricated satisfactorily for 48 hours at 425 degrees F."

Fig. 16 clearly shows the ball path running across the picture. This ball path has the same type of surface found on the bearing operated under starved-lubrication conditions. The light strip running diagonally across the path was made by a knife blade in chipping off the carbonized material. This particular grease lubricated satisfactorily for 48 hours at 425°F.

All bearings were found to have broken ball retainer cages where seizure occurred at 450°F. and 475°F.

CONCLUSION

Until this latest machinery for high temperature testing of ball and roller bearing lubricants was perfected, the reliability of results obtained from previous devices was questionable. Obviously, reproducibility of results is a most important factor. Unless this is possible, correlation of laboratory procedure with operating service cannot be accomplished. This newest machine has an additional advantage in that, while presently built to operate at 10,000 r.p.m., with but minor changes in construction, it can be speeded up to around 30,000 r.p.m. This availability of a machine for testing anti-friction bearings under high temperature and very high speeds opens another field for further research.

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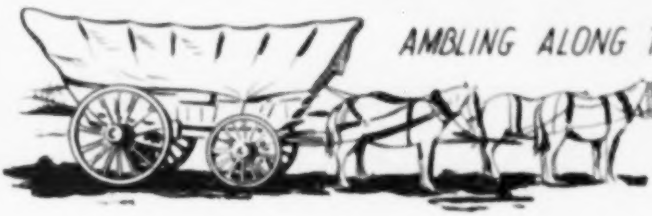
Greas-Events

CONESTOGAS to HIGHWAY TRANSPORTATION

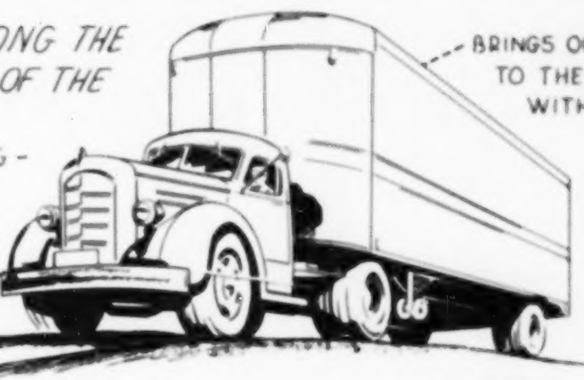


AMBLING ALONG TO 1849 GOLD FIELDS...

THIS CONESTOGA WAGON FREQUENTLY STOPPED FOR TALLOW TO BE SMEARED ON SQUEAKY AXLES.

WHIRLING ALONG THE SAME ROUTE OF THE 49'ERS...

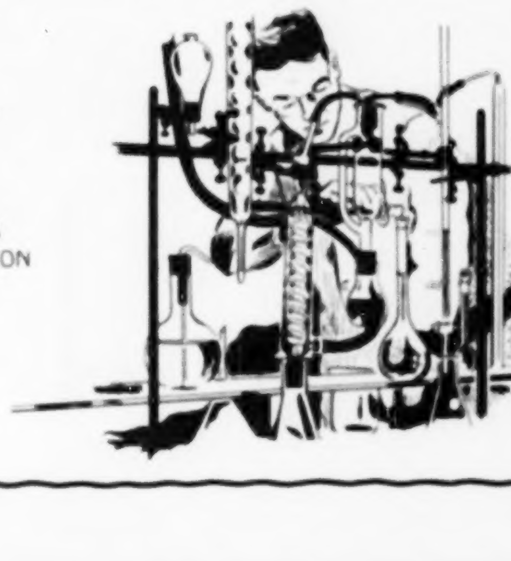
MODERN TRUCKING – A STRICTLY AMERICAN INSTITUTION –

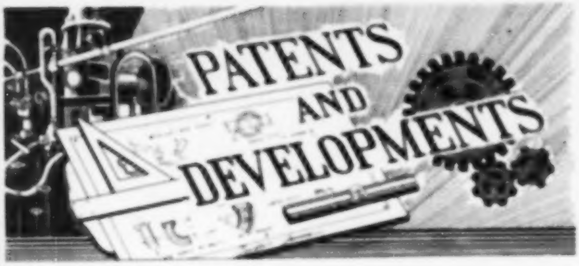


BRINGS OUR MARKETS TO THE CONSUMER WITH SPEED AND SAFETY.

A LABORATORY TECHNICIAN IS THE DIFFERENCE...

MODERN TRUCKING WOULDN'T BE MUCH FASTER THAN A CONESTOGA IF HE HADN'T DEVELOPED PRECISION LUBRICATING GREASES TO MEET CARRIER'S DEMANDS FOR RELIABILITY.



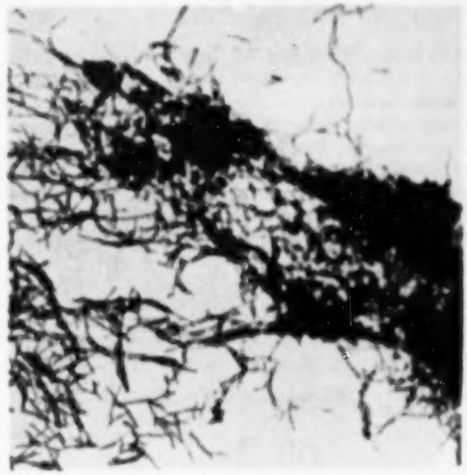


STABILIZED CALCIUM SOAP BASE GREASE—One patent issued to Standard Oil Development Co. (2,514,331) relates to the production of a grease which remains stable at high temperatures even after structural water is boiled away. The patent is based on the discovery that a calcium grease structure may be made stable above the boiling point of water by addition of extremely finely divided silica having colloidal properties. The base material is obtained by collecting the smoke or vapors obtained on combustion of volatile silicates such as ethyl silicate and the average particle size should not exceed 100 millimicrons.

Such finely divided silica has excellent grease forming properties itself due to apparently elongated or chain-like structure and high oil absorbing properties.

Figure 1 is a drawing prepared from an electron photomicrograph, showing the structure of calcium soap fibers as modified by condensed silica in a lubricating grease. The twisted cord-like elements represent the normal calcium soap structure with water incorporated therein. The dark areas indicate concentrations of the silica. This photograph, which shows a magnification of about 100,000, makes it appear that the deposits of silica are substantial, but in reality they are extremely small and close together and are sufficient to prevent breakdown of the soap structure when the water is removed by heating, etc.

LOW TEMPERATURE LUBRICATING GREASES—Another patent issued to Standard Oil Development Co. involves the use of dibasic acid esters in greases for low temperature uses. Since the torque necessary to turn a bearing lubricated by grease is directly proportional to the viscosity of the oil used in the grease at the particular temperature, it has been necessary in the manufacture of low temperature greases to use low boiling mineral oil fractions, since such fractions have low viscosity at such temperatures. However, since the equipment, such as the shutter of an aerial reconnaissance camera, on which the grease is to be used, may at times be subjected to relatively high temperatures, say 150° F, the low boiling mineral oil used in making the grease would be too volatile under such conditions.



It was found that esters of aliphatic dibasic acids, particularly esters in which the esterifying radical is a branched chain alkyl radical, may be used to replace a part of the mineral oil fractions in such greases. In such esters the bivalent aliphatic hydrocarbon radical may be methylene, polymethylene, ethylidene, propylidene, etc., and examples of such esters are isobutyl 2-ethylhexyl sebacate, di-2-ethylhexyl azelate, etc. The properties of such esters are of interest and are given in Table I.

TABLE I

Name of Ester	Centistokes Viscosity at— 210° F.	100° F.	—40° F.	Slope on ASTM Viscosity-Temp. Chart for the Interval of 210° F. to —40° F.	Visc. Index	Flash Point	Pour Point, °F	Approximate Boiling Point, °F. at Atmospheric Pressure
Di-secondary butyl sebacate	2.09	6.42	320	0.752	136	355	—90	650
Di-2-ethylhexyl sebacate	3.31	12.64	1,532	0.707	152	430	—90	760
Di-undecanyl sebacate[1]	4.66	22.83	8,000	0.716	138.5		—85	
Di-2-ethylhexyl alkylated sebacate	5.56	42.72	[2]200,000	0.812	68.5		—45	
Di-2-ethylhexyl azelate	3.05	11.25	1,200	0.729	147	410	—40	750

[1]Alcohol-5 ethyl nonanol 2

$$\underset{C_2H_5}{C_4H_9CH}—\underset{OH}{C_2H_4CH}—CH_3$$

[2]Extrapolated from the 100 and 210° F. values.

One example of a suitable grease prepared with such material contains 17% by weight of hydrogenated fish oil acids, 2.88% lithium hydroxide monohydrate, .5% phenyl alpha naphthylamine, .5% zinc naphthanate, 23% mineral oil of 58 S.S.U. at 100° F and 56.12% of di-2-ethylhexyl sebacate. Greases containing a substantial quantity of mineral lubricating oil, for example 20-70% by weight, together with such esters in quantities of 80-30% of the weight of liquid medium, are quite satisfactory and possess certain advantages over lubricants prepared using only the ester. Such greases passed the copper corrosion test and are superior, in the bleeding test, to greases containing only the ester and soap. Addition of the amphoteric soap also is an advantage (U.S. 2,521,438).

NON-HYDROCARBON LUBRICATING GREASES—Although mineral lubricating oils possess excellent lubricating properties and other valuable properties, it is recognized that they possess certain inherent limitations, such as the tendency to oxidize, thicken at lower temperatures, etc. One Shell patent (U.S. 2,524,563) discloses the production of non-hydrocarbon lubricants and, although the specification of the patent is almost completely devoted to the production of lubricating oils, it does contain some claims on lubricating greases of this type.

The grease base is a liquid polymer such as the polymer of allyl butyrate, allyl trimethylacetate, allyl caproate, allyl-2-ethylhexoate, allyl 2-methylvalerate, allyl phenoxyacetate, which polymers are reasonably stable to oxidizing influences and show excellent response to oxidation inhibitors such as aromatic amines including 2-hydroxy-5-nitraniline, p-anisidine, 2,4-xylidene, N,N'-dibutyl-p-phenylenediamine, 3,4-diamino toluene, p-phenylenediamine, p-phenylaminophenol and similar inhibitors. Anti-corrosion agents such as organic phosphites, including alkyl and aryl phosphites such as trimethyl phosphite, triamyl phosphite, etc., may be added.

The polymer of allyl caprylate, for example, is obtained by heating the monomer in a carbon dioxide atmosphere for 24 hours at 150° C whereupon a liquid is obtained of SAE grade having a viscosity index of 129, compared to 130 for the monomer. A polymer of allyl caprylate, when blended with 1% tributyl phosphite and 1% phenyl-alpha-naphthylamine has the following properties:

Viscosity, centistokes at 100° F	74.4
Viscosity, centistokes at 210° F	11.72
Pour point, °F	—45
Viscosity index	137
SAE grade	30

SILICONE GREASE DATA—Dow Corning Corp. has issued a data sheet on how to use its Dow Corning 44 silicone grease in the bearings of electric motors (Ref. No. 44-2).

HYDROXY METAL SOAPS—A process for producing a dispersed hydroxy heavy metal soap in a dehydrated organic vehicle has been described by Nuodex Products Co. of Canada, Ltd. and involves thermally dehydrating in miscible organic vehicle, an aqueous magma comprising the reaction product of alkali soap of at least one water soluble non-volatile organic acid, free alkali hydroxide, and a suffi-

cient quantity of water soluble salt of at least one heavy metal to completely react with the alkali soap and the free alkali, thus forming the hydroxy heavy metal soap dispersed in substantially insoluble form in the dehydrated organic vehicle (Canadian Patent 468,825).

GREASE PUMP—Alemite Div. of Stewart Warner Corp. has introduced three new air operated high pressure pumps for delivering lubricants from 25, 35, or 50 lb. original containers (American Aviation 10/2/50 p. 39).

PATENTS AND APPLICATIONS—

U. S. PATENT

2,524,201 (Josam Manufacturing Co.) — Air relief for grease interceptors.

CANADIAN PATENT

468,497 (Electro-Hydraulics, Ltd.)—Grease pumps.

BRITISH PATENT

644,395 (Shell Oil)—Lubricating greases containing lead soaps.

BRITISH APPLICATION

17914/49 (Standard Oil Development Co.) — Alkaline earth metal soap greases.

J. A. ALTSHULER OF STRATFORD ENGINEERING CORP. DIES

Joe A. Altshuler, 48, vice-president of the Stratford Engineering Corporation, Kansas City, Missouri, died November 26 at the Menorah hospital. He suffered a heart attack November 23 at the home, 4618 Warwick Boulevard.

A chemical engineer who specialized in petroleum refining, Mr. Altshuler spent several years abroad while supervising the construction of refineries.

In 1931 he went to Romania to direct the building of a refinery for a British petroleum company and stayed there for a year. From 1932 to 1935 he traveled in France, where he was Stratford's representative for the Alco Products Company, a subsidiary of the American Locomotive Company.

In 1948 he went to England to complete arrangements for the construction of a refinery there and late last year he toured Europe to make a survey of petroleum industries. His wife, Mrs. Minnie Altshuler of the home, accompanied him on the trips.

Mr. Altshuler was born in Iowa Falls, Ia., and had been a resident in Kansas City more than 20 years. He received a bachelor of science degree in engineering from the University of Pittsburgh in 1923, worked for the Associated Oil Company, San Francisco, until 1928, when he joined Stratford.

Mr. Altshuler, a former president of Congregation B'nai Jehudah, was a member of the board of trustees of the congregation, the board of directors of the Jewish Community center and the board of counselors of the Menorah hospital. He was president of the congregation two and one-half years until last May.

Surviving besides his wife are his mother, Mrs. Sara Altshuler, and a sister, Mrs. John Krawetz, both of Evanston, Ill., and a brother, Alfred Altshuler, Greenwood, Miss.

Services were held November 28 at the B'nai Jehudah temple. Entombment is at the Rose Hill mauseleum.

Chairman T. G. Roehner, Director of the Technical Service Department, Socony-Vacuum Laboratories

The Annual Meeting of the Technical Committee was well attended and the consensus of opinion expressed to the Chairman was to the effect that it represented time well spent. The minutes are being prepared at this date and should be distributed by Mr. Harry F. Bennetts before the end of December.

As a general observation, it may be stated that the inventory taken of work by ASTM Technical Committee G, Coordinating Research Council, and the National Lubricating Grease Institute on lubricating grease test methods definitely showed that important progress is being made on that aspect of our industry's problems. The beneficial effects of this activity are not always clearly evident. Much of the language peculiar to the industry originates with those test methods. For example, discussions of lubricating greases usually do not proceed very far without mention of penetration as means for describing the product. Widespread adoption and standardization of methods promotes the use of a common language which, in turn, facilitates the exchange of information within the industry and with consumers. It is possible, therefore, that one of the more important dividends from cooperative committee activities may be somewhat hidden by the greater amount of attention devoted to the details of the methods themselves. The work done by our Panel on Delivery Characteristics of Dispensing Equipment for Lubricating Greases may be cited as an example. At the present time pumpability tests are run by a wide variety of procedures and the data therefrom cannot be pooled. Publication of the method developed by this Panel, in The Institute Spokesman in the near future, is expected to lead to a narrowing of the variations to an extent that experience within the industry can be reasonably coordinated.

Since the meeting, the NLGI representatives on the so-called AAR-AFBMA-NLGI Cooperative Committee on Grease Test Methods have been nominated. They are:

Mr. H. E. Achilles, Tide Water Associated Oil Company
Dr. E. W. Adams, Standard Oil Company (Indiana)
Mr. Gus Kaufman, The Texas Company
Mr. G. E. Merkle, Fiske Brothers Refining Company

with your Chairman as ex-officio. The interim Chairman before the organization meeting is Mr. H. T. Rockwell, of the New York Central System and Chairman of the Association of American Railroads' Committee on Lubrication of Cars and Locomotives. This meeting was held on November 29 and the outcome will be reported in the next Technical Committee Column.

GREASONALITIES

FENNELLY NAMED TO BOARD OF STEWART-WARNER CORPORATION

John F. Fennelly, partner, Glore, Forgan and Company, Chicago, has been elected to the board of directors of Stewart-Warner Corporation, James S. Knowlson, president and board chairman, announced. His election fills the vacancy caused by the death of Charles F. Glore.

Fennelly has been with Glore, Forgan and Company, and the predecessor company, Field, Glore and Company, since 1931. He became a partner in 1935. He is vice president of the Investment Bankers Association of America, secretary of the Commercial Club of Chicago, was executive director of the Committee for Economic Development in 1943-44, and was vice chairman of the Requirements Committee and Director of the Program Bureau of the War Production Board in 1942-43.

A native of New Orleans, he is a graduate of Princeton, from which he holds a doctorate. He taught at Columbia and was an economist for National City Company, New York, prior to joining Field, Glore & Co.

DEEP ROCK OIL CORPORATION NAMES SWAYZE ASSISTANT TO LAND MANAGER

L. M. Swayze, who has been active as an independent oil lease broker in the Southwest since 1942, was appointed assistant to Deep Rock Oil Corporation's Land Manager F. E. Swenson, according to an announcement by John L. Ferguson, vice president of the company's land and exploration division.

A native Kansan, Mr. Swayze went to Tulsa first in 1919 and was employed by the Producers State Bank. Later he entered land and lease work and migrated to south Arkansas just before the Eldorado field was discovered and joined the Humphries Oil Corporation. He returned to Tulsa in 1921 to work for the Red Bank Oil Company, an association which continued for ten years.

In 1931 he embarked on his first tenure as an independent trader which lasted four years, then he joined the Fohs Oil Company in Houston, Texas, to head its land, lease and title work for seven years. He again entered the independent brokerage field in 1942 to operate in Louisiana, Texas and Oklahoma.

In 1947 Mr. Swayze transferred his headquarters from Houma, Louisiana, to Tulsa where he has maintained a home for 27 years despite his travels.

N.L.G.I. ADMITS TEN NEW MEMBERS IN 1950

One of N. L. G. I. Past President A. J. Daniel's goals, to increase the membership of the Institute by ten in 1950, was another ambition realized during his year as president. Since January 1, ten more companies have become members of the Institute, either active or associate. No new technical members have been accepted so far this year.

The new members, in the order in which they have joined, and their company representatives, are as follows:

Rheem Manufacturing Company, New York, New York, G. W. Gates—associate; Farmers Union Central Exchange, Inc., St. Paul, Minnesota, H. F. Wagner—associate; National Steel Container Corporation, Chicago, Illinois, Henry Rudy—associate; Pennsylvania Refining Company, Cleveland, Ohio, Don E. Hodgson—active; The Ohio Corrugating Company, Warren, Ohio, Lawrence F. McKay—associate.

E. I. du Pont de Nemours and Company, Wilmington, Delaware, J. R. Sabina—associate; Leffingwell Chemical Company, Whittier, California, D. E. Murphy — associate; General Lubricants Company, Minneapolis, Minnesota, Robert F. Pomeroy—active; Morehouse Industries, Los Angeles, California, George E. Missbach—associate; and Synthetic Products Company, Cleveland, Ohio, G. B. Curtiss—associate.

NOT A GREASONALITY—BUT INTERESTING

The Chamber of Commerce of the United States recently made a survey among ordinary people. One of the questions asked was:

"Who did the most for you last year?"

51% replied that the Union did.

40% said they felt the Government did the most for them.

9% said that Business did.

Looks as though Business is a bit short on its public relations with employees. How about using that industrial publication most of us issue to employees as a vigorous medium for explaining the American way of life?

FUTURE INDUSTRY MEETINGS

DECEMBER, 1950

26-31 American Assn. for the Advancement of Science (annual meeting) Hotel Statler, Cleveland, Ohio

JANUARY, 1951

8-9 Kansas Oil Men's Assn. (Annual Convention), Lassen Hotel, Wichita

8-12 Socy. of Automotive Engineers (annual meeting and Engineering display) Hotel Book-Cadillac, Detroit, Mich.

22-26 American Inst. of Electrical Engineers (winter general meeting), Hotel Statler, New York, N. Y.

25-26 Northwest Petroleum Assn. (annual convention), Nicollet Hotel, Minneapolis, Minn.

FEBRUARY, 1951

20-21 Kentucky Petroleum Marketers Assn. (annual meeting, convention, and trade show), Brown Hotel, Louisville, Ky.

27-28 Wisconsin Petroleum Assn. (annual convention and equipment show), Milwaukee Auditorium, Milwaukee, Wisc.

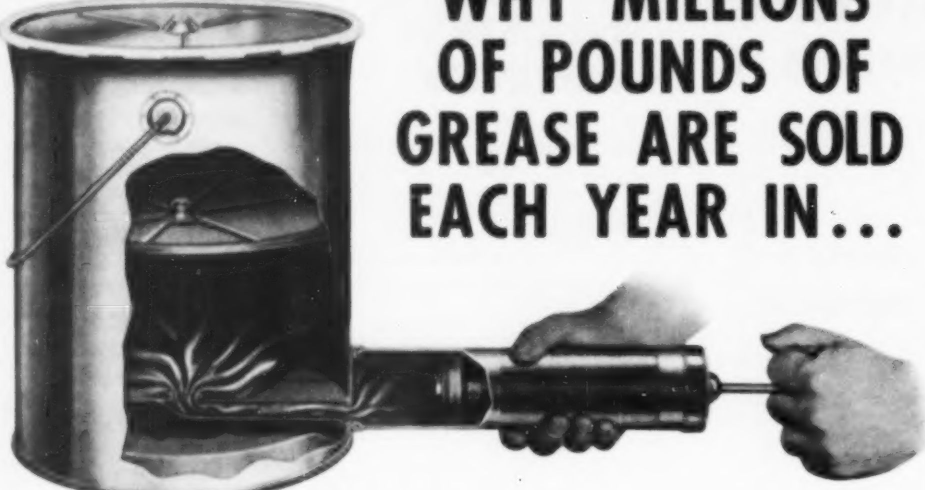
5-7 Manufacturers Standardization Socy. of the Valve & Fittings Industry (annual meeting), Commodore Hotel, New York, N. Y.

6-8 Socy. of Automotive Engineers (passenger car, body, and materials meeting), Hotel Book-Cadillac, Detroit, Mich.

7-9 AMERICAN PETROLEUM INSTITUTE (Division of Production, Southwestern district meeting), Hotel Beaumont, Beaumont, Texas

(Continued on page 32)

WHY MILLIONS OF POUNDS OF GREASE ARE SOLD EACH YEAR IN...



G. P. & F. E-Z-FILL Grease Gun Loader Containers

CONVENIENCE . . . *that's the big reason for the popularity of this container. E-Z-FILL saves a lot of work for the man who uses a grease gun. It's a gun filling specialist that allows the grease to be drawn directly from the pail without removing the cover.*

IT'S CLEAN — There is no messy handling involved. The grease never touches anything except the inside of the pail and the inside of the gun. The shut-off disc prevents drippings before and after the gun is filled.

IT'S FAST — Because it's simple to use. Just screw the gun into the socket, draw out the plunger and remove the gun. That's all there is to it.
As the grease is drawn out a follower plate moves down and controls its uniform removal. No air pockets in the gun.

IT'S ECONOMICAL — Because there is no wasted grease. Dirty grease is wasted money . . . but in this pail it can't get dirty because it is never exposed. Dirt, grit and moisture can't get into it.

Farmers, industrial plants, garages . . . anyone who uses grease . . . appreciates and wants these conveniences.

Are you selling part of these millions and millions of pounds of grease that are bought each year in E-Z-FILL Grease Gun Loader Containers? Why miss your share of this tremendous market?

AVAILABLE NOW IN 25 AND 35 POUND SIZES

Write today for more details on the E-Z-Way to boost your sales.

G.P.&F. STEEL CONTAINERS

GEUDER, PAESCHKE & FREY CO.
300 NORTH 15TH STREET • MILWAUKEE 3, WISCONSIN

THE N.L.G.I GUIDE POST

Industry CROSSROADS FOR BUYERS and SELLERS

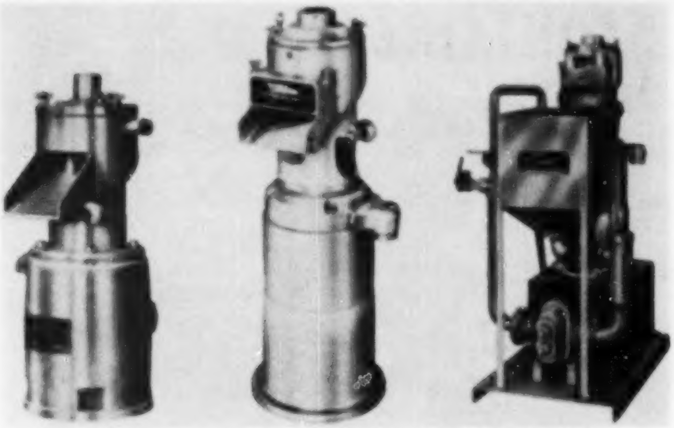
SUPPLIERS OF MATERIALS FOR MANFACTURING LUBRICATING GREASES

MANUFACTURERS OF EQUIPMENT FOR APPLICATION OF LUBRICATING GREASES

DESIGNERS OF GREASE INDUSTRY EQUIPMENT

NEWS About Your Industry

MOREHOUSE DEVELOPS THREE NEW SPEEDLINE MILLS



New Morehouse Speedline Mills for grease manufacturing. Left to Right, Model MG, Model B-1405 and Model B-1405 with deaerator unit

Three new Morehouse Speedline mills especially designed for processing greases and lubricants and a new deaerator unit for eliminating entrained air have been developed by Morehouse Industries of Los Angeles, according to D. L. Grubbs, general manager.

The new mills, perfected by Morehouse engineers with the cooperation of some of the world's largest grease manufacturers, have set high production records in the processing of a wide variety of greases, including metallic-soap base and other new solid additive types. Production records as high as 8000 lbs. per hour have been reported. Better dispersion in smooth-type greases, with greatly improved texture and appearance are also reported.

The new mills are Model MG designed for laboratory testing and control and custom runs, which weighs only 145 lbs., Model B-1405 with capacities as high as 8000 lbs. per hour, and Model B-1405 with or without deaerator unit.

The famous Morehouse Speedline grinding principle which for many years has been used with outstanding success in fine grinding, dispersing, mixing and disintegrating of a wide variety of materials ranging from water-thin to heavy paste viscosities, is employed in the new grease models. Other materials successfully processed in Speedline mills include chemicals, paints, inks, cosmetics, foods and plastics, both of a corrosive and non-corrosive nature. Mills are available in both cast-iron and stainless steel.

Outstanding features of all Morehouse mills are consistently high production records, compactness of design, ease of installation, portability and economy of operation. All parts are easily cleaned and are quickly interchangeable. They can be supplied in a wide variety of electrical requirements.

Complete information on Speedline mills can be obtained by writing Morehouse Industries, 1156 San Fernando Road, Los Angeles 65, California.

EMERY INDUSTRIES, INC. ANNOUNCES NEW PRODUCTS

Emery Industries, Inc., announces the commercial production of Emery 12-Hydroxystearic Acid and Hydrogenated Castor Oil and also the availability of a descriptive bulletin covering the two new Emery products. The booklet contains complete specifications, physical and typical characteristics of each product. Also discussed are typical uses and suggested uses based on preliminary experimentation. There also is a complete bibliography for each.

12-Hydroxystearic Acid is an 18-carbon saturated fatty acid with a hydroxyl grouping on the 12th carbon atom. The presence of this reactive hydroxyl radical produces unique chemical and physical properties, and makes this product very promising as a chemical intermediate for synthesis of new products. One major established use is in the manufacture of lithium base lubricating greases, with many more specialty uses, such as esters, soaps, alkanol amine salts, being suggested.

Emery 12-Hydroxystearic Acid is a hard amorphous solid fatty acid with a capillary melting point of approximately 73° C. The free fatty acid content as a 300 molecular weight fatty acid is 95% minimum. Other characteristics are low iodine value and light color.

Emery Hydrogenated Castor Oil is a hydrogenated triglyceride consisting of approximately 85% of combined hydrogenated ricinoleic acid (12-hydroxystearic). It is a hard amorphous solid with a melting point of approximately 82° C. and an iodine value of 5.0 maximum. In addition, color is light and acid value low.

Principal use is in lubricating greases but shows promise in many specialty uses such as impregnating and insulating agents for electrical products.

A descriptive bulletin on both Emery 12-Hydroxystearic Acid and Emery Hydrogenated Castor Oil is available on request.

FUTURE MEETINGS OF YOUR INDUSTRY

FUTURE MEETINGS

(Continued from page 25)

8-9 Indiana Independent Petroleum Assn. (spring convention and refiners and suppliers exhibit). Hotel Severin, Indianapolis, Indiana

APRIL, 1951

11-13 American Inst. of Electrical Engineers (district No. 4 meeting), Miami, Fla.

16-18 Socy. of Automotive Engineers, (national aeronautic meeting and aircraft engineering display), Hotel Statler, New York, N. Y.

16-18 American Socy. of Lubrication Engineers (annual convention—annual lubrication show) Bellevue-Stratford Hotel, Philadelphia, Pa.

18-20 National Petroleum Assn. Hotel Cleveland, Cleveland, Ohio

FORMER MONSANTO CHEMIST, KOSOLAPOFF, WRITES BOOK

John Wiley & Sons, New York, have announced the publication of a new book, "Organophosphorus Compounds," written by Gennady M. Kosolapoff.

The book offers a complete, modern coverage of the preparation and chemical properties of the organic compounds of phosphorus. Discussing all the known synthetic methods of preparation, the book contains an exhaustive, up-to-date list of authentic compounds used in the production of plasticizers and synthetic resins, wetting agents and detergents, antioxidants and stabilizers, lubricants, flame-retarding materials, ore flotation agents, pharmaceutical compounds, and many other products. The author has also included pertinent references to original literature for detailed information on specific compounds.

Formerly senior research chemist for the Monsanto Chemical Company, Dr. Kosolapoff is now associate professor of chemistry at the Alabama Polytechnic Institute.

NEW

MOREHOUSE

SPEEDLINE MILL

Specially designed for

LUBRICANTS and COMPOUNDS

Revolutionary Performance Proved in Plant Operation

Now there's a Morehouse Mill for the grease manufacturing business that doubles the production of ordinary equipment—in a fraction of the space, at a fraction of the cost! It is based on the principle that has made Morehouse Mills the standard for big-volume production in paint, printing-ink and similar fields.

This mill is setting new production records on a wide variety of greases, including metallic-soap base, Bentone[1] and Santocel[2]. Production rates up to 8,000 lbs. per hr. have been reported. It's setting new standards of quality, too, producing lubricants with appearances and textures that will amaze you.

Efficient on Liquid Lubricants with Additives

In addition to milling of greases, it is extremely valuable for producing faster saponification reaction in the kettle, as a dispersion mill for decolorizing clays in the production of light colored lubricating oils, and for the production of liquid lubricants containing several additives requiring complete dispersion to gain the most desirable properties.

The Morehouse Mill is compact and versatile. It can be adjusted quickly and accurately. It can be easily transported by lift truck for use anywhere in your plant. It is easy to clean and all parts are readily accessible and are interchangeable. Last but not least, Morehouse Mills are low in original cost and economical to operate and maintain. Write for complete details today.

[1]Product of National Lead Company, Baroid Sales Division.

[2]Product of Monsanto Chemical Company, Merrimac Division.

Morehouse Mills are
AVAILABLE FOR TEST IN YOUR PLANT
Write for details

MOREHOUSE
"Famous for quality since 1898"

MOREHOUSE INDUSTRIES

Originators and sole manufacturers of Morehouse Speedline Equipment

1156 San Fernando Road, Los Angeles 65

Eastern Sales: 707 Henry Grady Bldg., Atlanta 3, phone ALpine 0634

Cable address: "MORESPEED Los Angeles"

some Glycerides are *unusual,* too

Spermafol 45 and 52 are two hardened fats with a unique composition. They differ from ordinary glycerides in that Spermafols contain a large portion of higher alcohol esters — and these esters result in some unusual characteristics.

For example, when you saponify Spermafol you get a soap containing thoroughly dispersed molecules of free fatty alcohols. The alcohols are good lubricants; and since they are extremely soluble in petroleum and other solvents, they tend to act as strong coupling agents for the soap.

Then, too, Spermafol is more alkali resistant than normal glycerides . . . will not easily hydrolyze or form fatty acids.

You can use Spermafol in making lubricants, textile sizes and other textile chemicals, leather chemicals, wax compounds, metal drawing compounds, and flax-type packings and gaskets. Specifications for Spermafol 45 and 52 are listed at left. Write for further information about their use in your products.

	SPERMAFOL 45	SPERMAFOL 52
Melting Point	44 to 46° C	49 to 52° C
Free Fatty Acids (as Oleic)	2.0% max.	2.0% max.
Acid Number	4.0 max.	4.0 max.
Iodine Number	26 to 30	7.0 max.
Saponification Number	133 to 146	135 to 145
Unsaponifiable (higher Alcohols)	33 to 38%	33 to 38%
Specific Gravity @ 100/25° C	0.825	0.823
Flash Point	451° F	482° F
Fire Point	545° F	545° F
Color	White	White

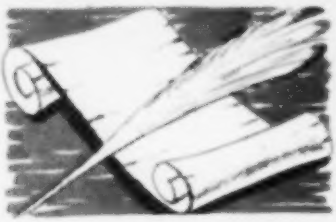
Hydrofol PRODUCTS

ARCHER-DANIELS-MIDLAND COMPANY

(THE WERNER G. SMITH CO. DIVISION)

Chemical Products Dept. — 2191 WEST 110th STREET • CLEVELAND 2, OHIO

Associate and Technical Members . . . of the National Lubricating Grease Institute



Supporting Your Organization These Suppliers of Your Industry Hold Membership in the N. L. G. I.

SUPPLIERS OF MATERIALS FOR MANUFACTURING LUBRICATING GREASES

Armour & Co., Chemical Division
1355 West 31st St.
Chicago 9, Illinois
Member—Dale V. Stingley

American Cyanamid Company
30 Rockefeller Plaza
New York City, New York
Member—A. Scharwachter

Darling & Company
4201 South Ashland Avenue
Chicago 9, Illinois
Member—George W. Trainor

E. I. du Pont de Nemours & Company
Wilmington, Delaware
Member—J. R. Sabina

Emery Industries, Inc.
Carew Tower
Cincinnati 2, Ohio
Member—R. F. Brown

Foote Mineral Company
18 W. Chelten Street
Philadelphia 44, Pennsylvania
Member—H. C. Meyer, Jr.

A. Gross & Company
295 Madison Avenue
New York City 17, New York
Member—Eugene Adams

W. C. Hardesty Co., Inc.
41 East 42nd Street
New York City, New York
Member W. G. McLeod

Harshaw Chemical Company
1945 East 97th Street
Cleveland 6, Ohio
Member—G. G. Unbefer

Leffingwell Chemical Company
P. O. Box 191
Whittier, California
Member—D. E. Murphy

Lubrizol Corporation
Euclid Station
Cleveland 17, Ohio
Member—J. H. Baird

Mallinckrodt Chemical Works
New York 8, New York
St. Louis 7, Missouri
Member—C. E. Cosby

N. I. Malmstrom & Company
147 Lombardy Street
Brooklyn 22, New York
Member—Ivar Wm. Malmstrom

Metasap Chemical Corporation
Harrison, New Jersey
Member—O. E. Lohrke

Monsanto Chemical Company
1700 Second Street
St. Louis 4, Missouri
Member—J. W. Newcombe

National Lead Company
105 York Street
Brooklyn 1, New York
Member—Alexander Stewart

National Rosin Oil Products, Inc.
R.K.O. Bldg., Rockefeller Center
New York City, New York
Member—Richard Bender

M. W. Parsons, Imports & Plymouth Organic Labs., Inc.
59 Beekman Street
New York City 7, New York
Member—H. Bye

Swift & Company, Industrial Oil Division
165th & Indianapolis Blvd.
Hammond, Ind.
Member—F. H. Beneker

Warwick Chemical Company
Division of the Sun Chemical Corporation
10-10 44th Avenue
Long Island City 1, New York
Member—Dr. J. J. Whitfield

The Werner G. Smith Co.
(Division of Archer-Daniels-Midland Co.)
2191 West 110th Street
Cleveland 2, Ohio
Member—F. C. Haas

Witco Chemical Co.
75 E. Wacker Drive
Chicago, Illinois
Member—B. W. Lewis

CONTAINER MANUFACTURERS

Central Can Company, Inc.
2415 West 19th Street
Chicago, Illinois
Member—Henry Frazin

Continental Can Co.
1103 Waldheim Building
Kansas City 6, Missouri
Member—T. A. Graham

Geuder, Paeschke & Frey Co.
324 North Fifteenth Street
Milwaukee 3, Wisconsin
Member—Willard J. Flint

Inland Steel Container Company
6532 South Menard Avenue
Chicago 38, Illinois
Member—G. D. Zuck

J & L Steel Barrel Company
405 Lexington Ave.
New York 17, New York
Member—Jerry Lyons

National Steel Container Corporation
6700 South LeClaire Avenue
Chicago 38, Illinois
Member—Henry Rudy

Ohio Corrugating Co.
917 Roanoke Ave. So. E.
Warren, Ohio
Member—L. F. McKay

Rheem Manufacturing Company
570 Lexington Avenue
New York, New York
Member—G. Wesley Gates

United States Steel Products Co.
30 Rockefeller Plaza
New York City 20, New York
Member—Wm. I. Hanrahan

Vulcan Stamping & Manufacturing Co.
300 Madison Street
Bellwood, Illinois
Member—Dale M. Harpold

MANUFACTURERS OF EQUIPMENT FOR APPLICATION OF LUBRICATING GREASES

The Aro Equipment Corporation
Bryan, Ohio
Member—R. W. Morrison

Balcrank, Inc.
Disney near Marburg
Cincinnati 9, Ohio
Member—R. P. Field

Gray Company, Inc.
60 11th Avenue Northeast
Minneapolis 13, Minnesota
Member—L. L. Gray

Lincoln Engineering Company
5730 Natural Bridge Avenue
St. Louis, Missouri
Member—Foster Holmes

National Sales, Inc.
812 North Main Street
Wichita, Kansas
Member—Howard Dearmore

Stewart-Warner Corp.
1826-1832 Diversey Parkway
Chicago, Illinois
Member—Walter Duncan

U. S. Air Compressor Company
5300 Harvard
Cleveland, Ohio
Member—C. A. Benning

LABORATORY EQUIPMENT AND SUPPLIES

Precision Scientific Company
3737 Cortland Street
Chicago 47, Illinois
Member—Alexander I. Newman

SUPPLIERS OF EQUIPMENT FOR MANUFACTURING LUBRICATING GREASES

Buflovak Equipment Division of Blaw-Knox Company
1543 Fillmore Avenue
Buffalo 15, New York
Member—A. W. Johnson

The Girdler Corp.
Louisville 1, Kentucky
Member—John E. Slaughter, Jr.

Morehouse Industries
1156 San Fernando Road
Los Angeles 65, California
Member—George E. Missbach

Stratford Engineering Corporation
1414 Dierks Building
Kansas City, Missouri
Member—J. A. Altshuler

Synthetic Products Company
1636 Wayside
Cleveland, Ohio
Member—G. B. Curtiss

REFINERS

Calumet Refining Company
4323 Southwestern Blvd.
Chicago, Illinois
Member—H. E. Semerau

Farmers Union Central Exchange, Inc.
P. O. Box G
St. Paul 1, Minnesota
Member—H. F. Wagner

Mid-Continent Petroleum Corporation
Tulsa, Oklahoma
Member—T. E. Fitzgerald

TECHNICAL AND RESEARCH ORGANIZATIONS

Cargill, Incorporated
200 Grain Exchange
Minneapolis 15, Minnesota
Member—Dr. Sabina Hirsch

Mellon Institute of Industrial Research
University of Pittsburgh
Pittsburgh 13, Pennsylvania
Member—Malcolm Finlayson

Midwest Research Institute
4049 Pennsylvania
Kansas City 2, Missouri
Member—Dr. Geo. E. Ziegler